

Effect of Processing and Subsequent Storage on Nutrition

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OBJECTIVES

- To determine the effects of thermal processing, freeze drying, irradiation, and storage time on the nutritional content of food
- To evaluate the nutritional content of the food items currently used on the International Space Station and Shuttle
- To determine if there is a need to institute countermeasures

*(This study does not seek to address the effect of processing on nutrients in detail, but rather aims to place in context the overall nutritional status at the time of consumption)

BACKGROUND

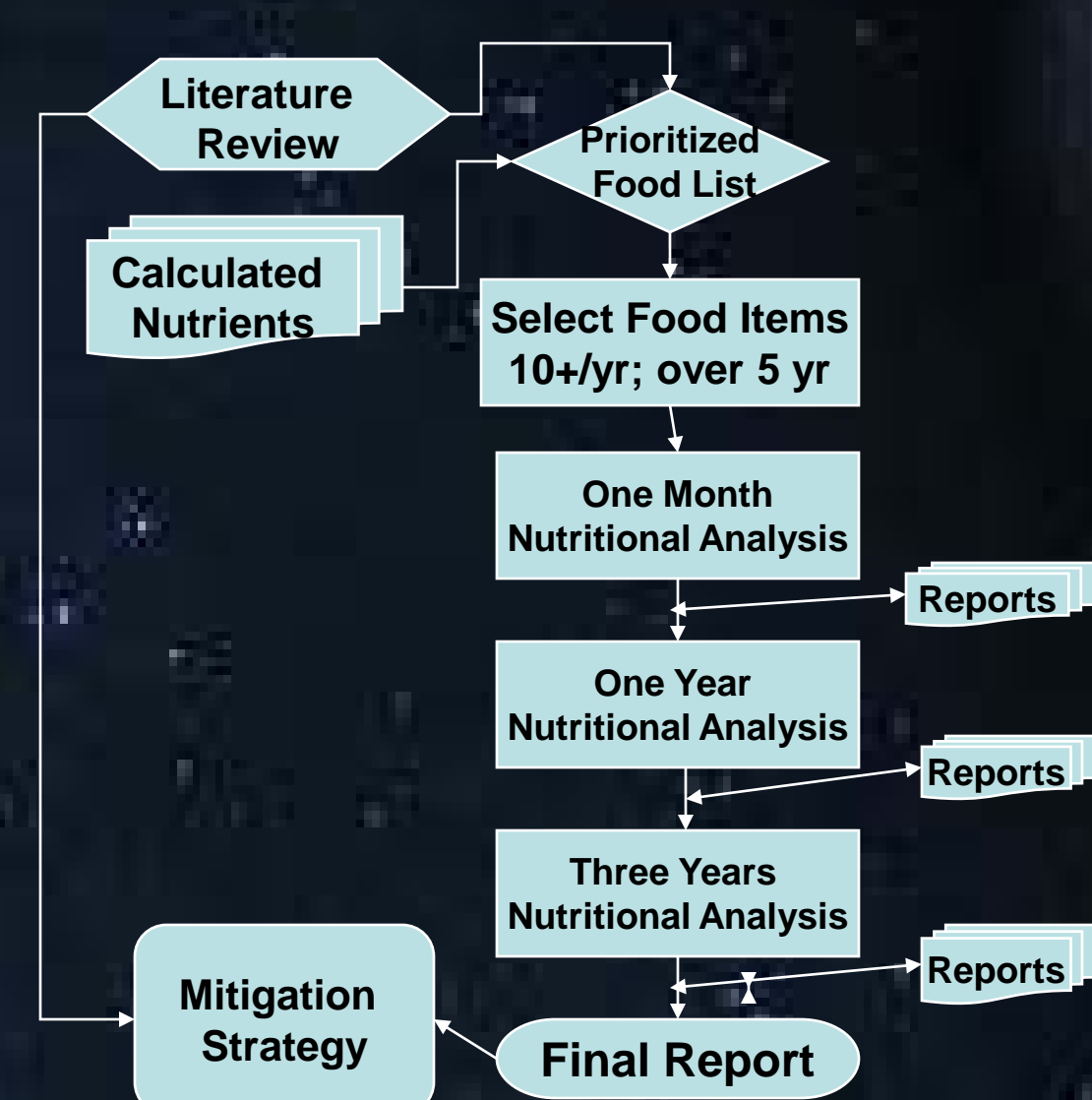
- Food products in space food systems are processed to commercial sterility
- While heat sterilization is the most effective food preservation process, it affects vitamin and protein quality
- The dehydration process has the smallest impact on nutrients
- Micronutrient stability is dependent upon the composite macronutrients matrix
 - A kinetic model only provides an estimate of the remaining nutritional contents
 - It is difficult to extrapolate between systems
- Food Composition Database does not take into account the effects of processing

JUSTIFICATION

- Food with a 5 year shelf-life will be required for a mission to Mars
 - Nutrient loss during processing and subsequent storage can be significant
- Nutrition requirements are delivered via the food system
 - The quantity of nutrients, e.g. vitamins, at consumption is currently unknown
- Nutrients play a vital role in facilitating the capability of astronauts to tolerate physiological changes
 - As mission durations increase, physiology changes gain importance

RESEARCH PROTOCOL

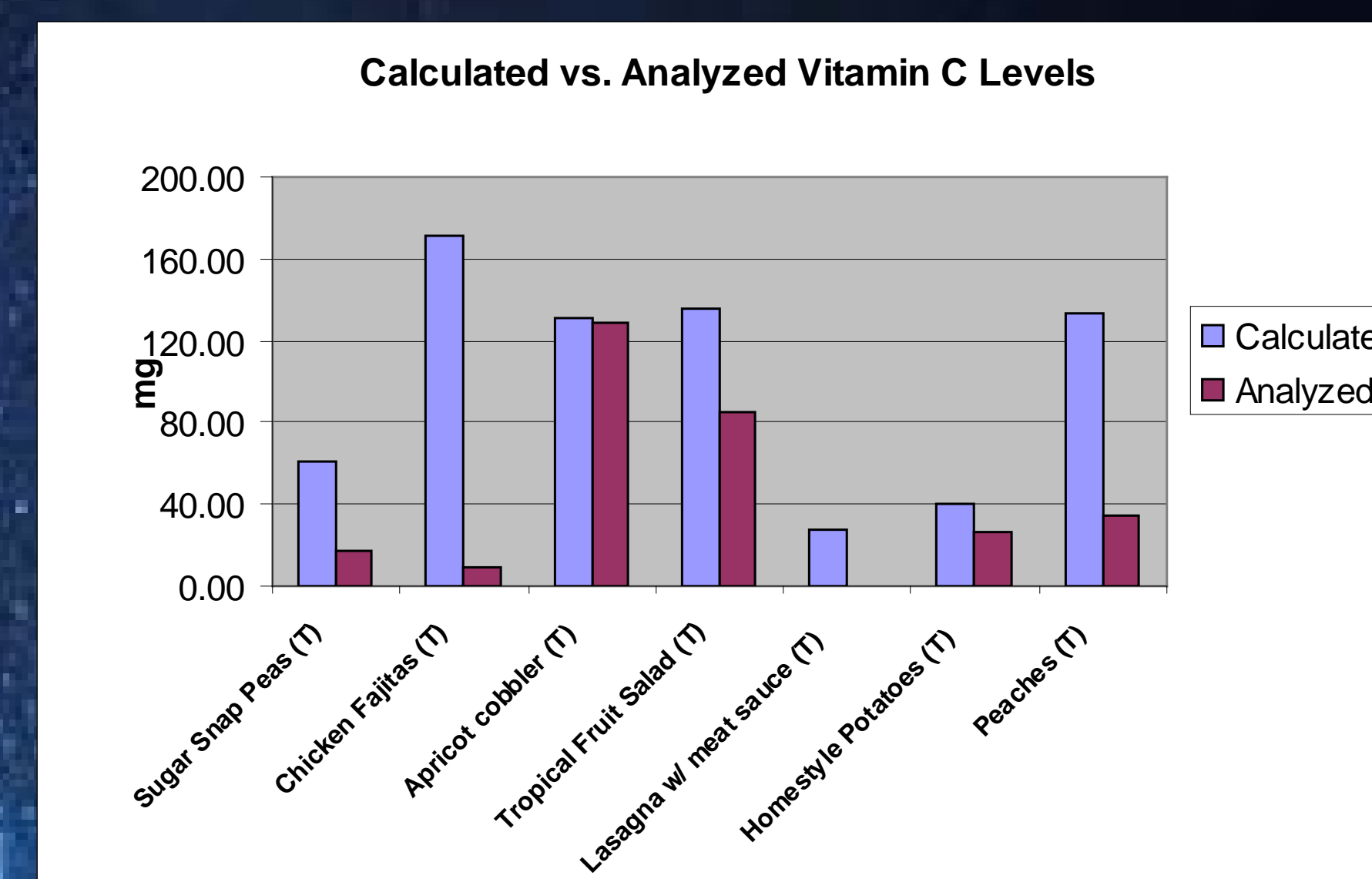
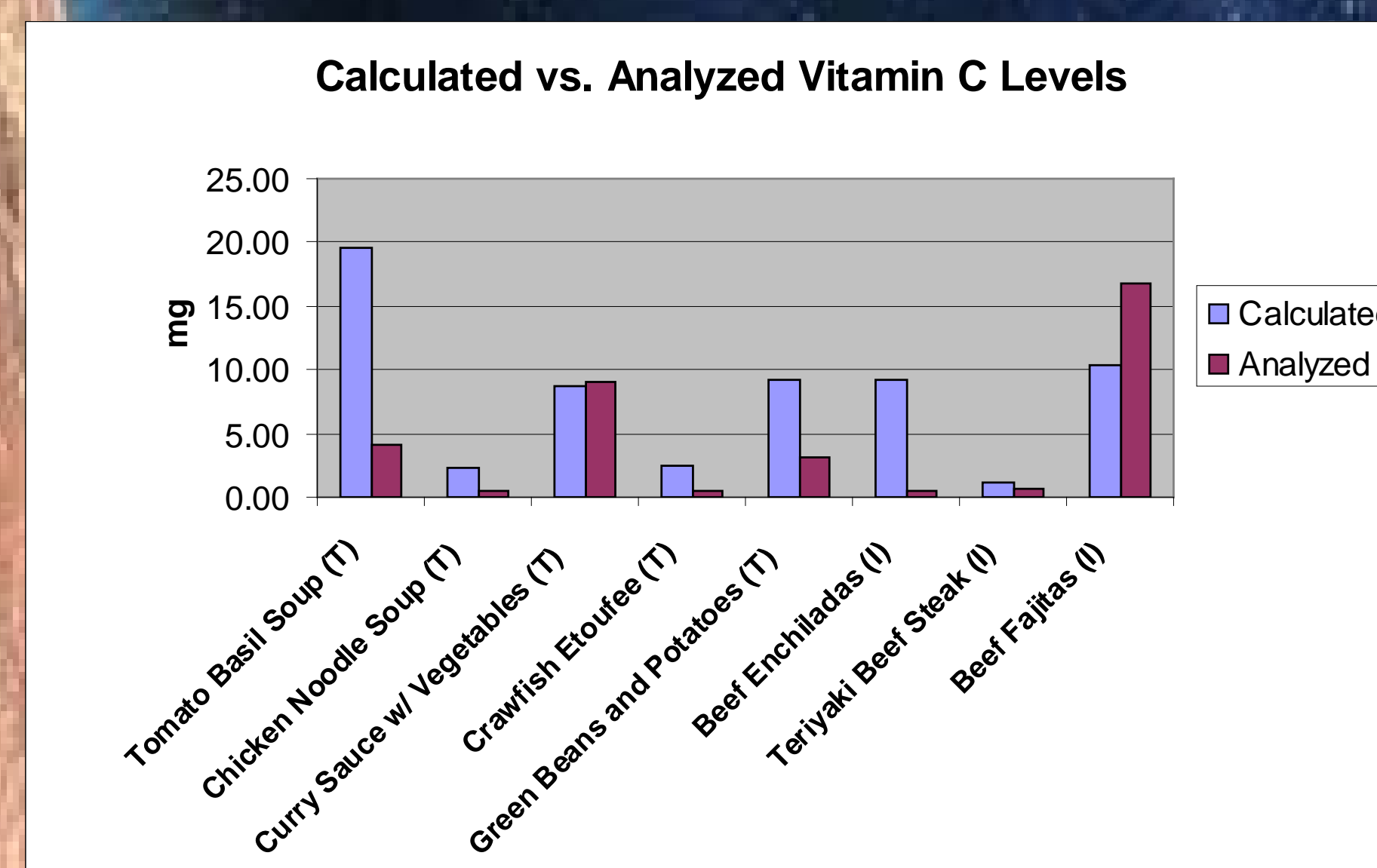
- Ten to twelve processed food items will be selected per year for five years
- Nutritional profile will be determined:
 - 1 month after processing
 - 1 year after processing
 - 3 years after processing
- Comparing
 - Calculated vs. analyzed
 - 1 month vs. 1 yr vs. 3yrs



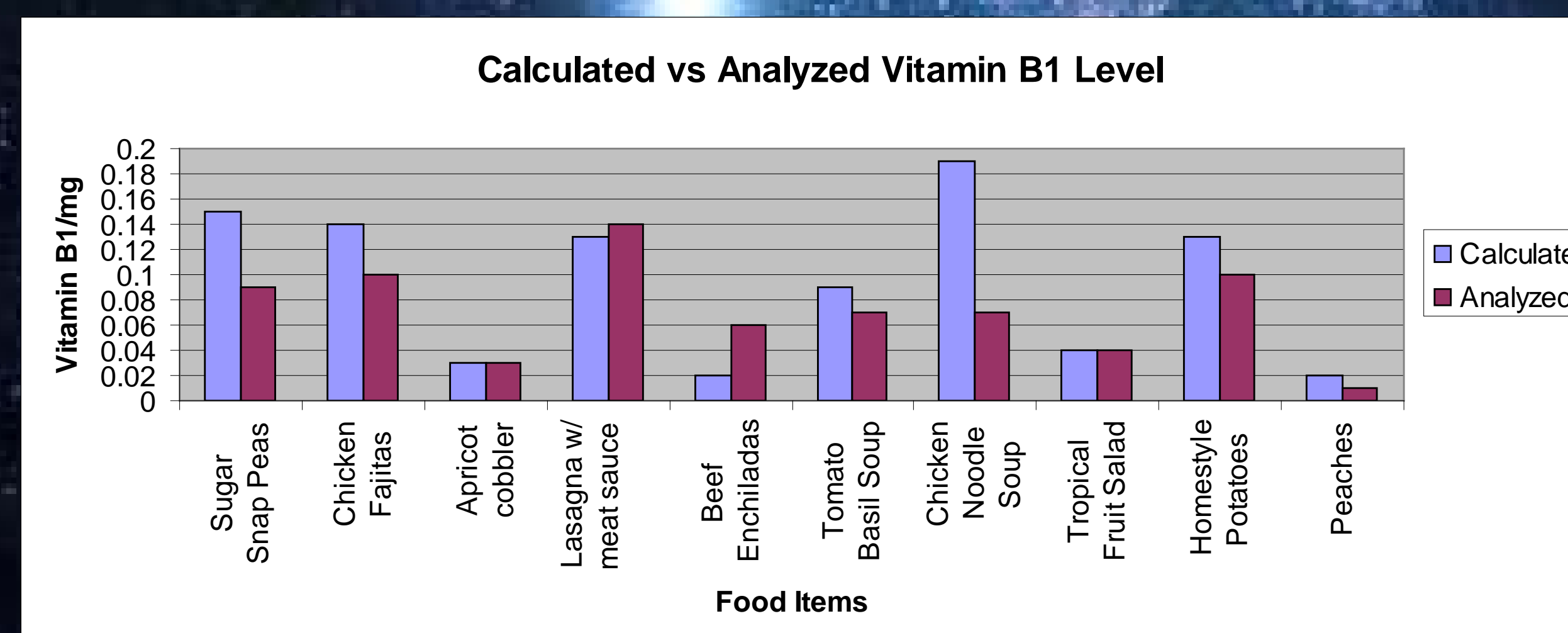
RESULTS AND DISCUSSION (1 month data)

- 15 products analyzed in FY08 one month after production
- The one month data provides input of nutritional content after processing
- Calculated values (based on nutritional databases from USDA and ingredient manufacturers) were compared to the analytical data

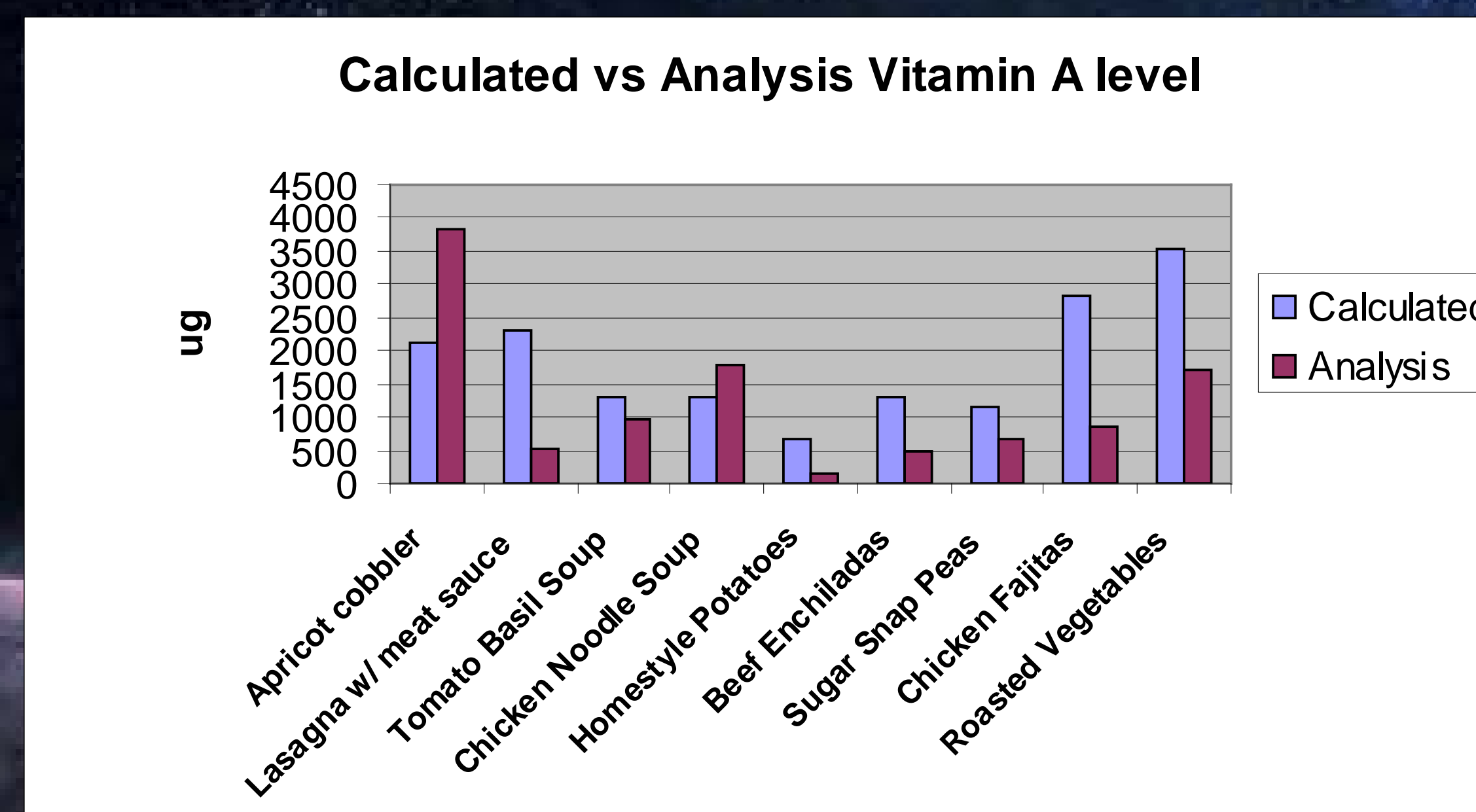
Vitamin C/Ascorbic Acid



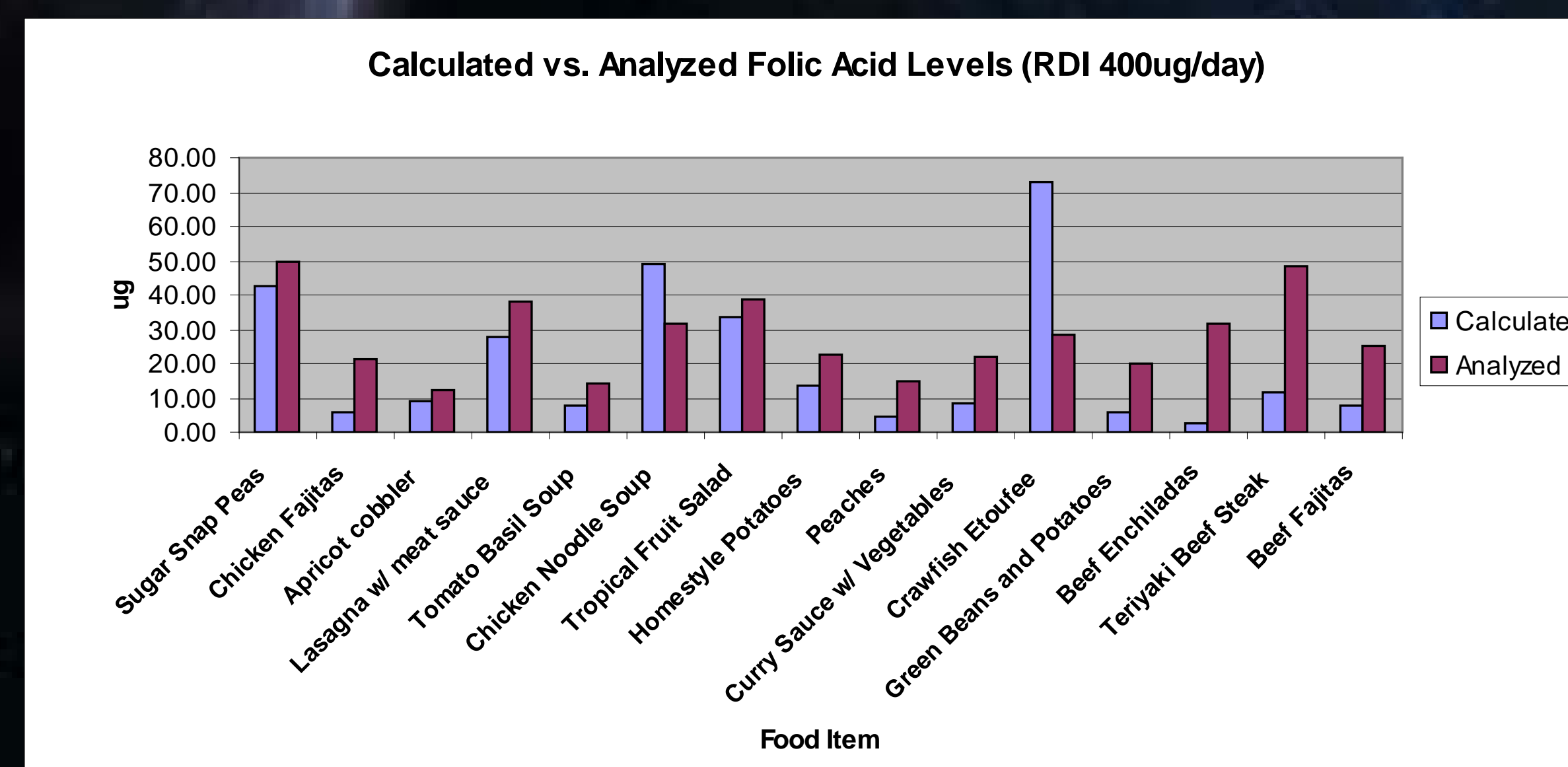
Vitamin B1/ Thiamin



Vitamin A/ Retinol/Carotenoid



Folic Acid



CONCLUSIONS

- Vitamin C loss is significant after both retort and irradiation processing (exception beef fajitas)
- Available data bases do not provide adequate nutrition data
- Results indicate that the thermostabilized process does not provide adequate nutrition for a long duration mission
- Other technologies such as high pressure processing and microwave sterilization need to be considered once FDA approved

EXPLORING COUNTERMEASURES

- Optimization of process, packaging and storage conditions for nutrient retention
- Exploration of alternative sterilization methods
- Maximization of available nutrients by reformulation using ingredients with dense intrinsic nutrients
- Treatments with food additives to provide nutrients, e.g. antioxidants
- Fortification with stable nutrient forms, e.g. encapsulation, chelating, analogs, etc.
- Cultivation of quick growing fruits and vegetables to deliver essential nutrients

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